Predator's path: Caucasian lynx captured by a camera trap in the Kars region. (Photo: Kuzey-Doğa.)

organisation KuzeyDoğa has for the past few years led studies of the carnivores in northeastern Turkey. With the first wolf-tracking project in Turkey, the research showed that these predators move much more widely than the confines of the protected areas. Within just two months they covered an area that was 13 times larger than the national park where they were caught and fitted with GPS/GSM transmitters that text-message the wolves' GPS coordinates to the researchers' cell phones.

After three years of persistence, in 2011, KuzeyDoğa succeeded in convincing the government of the idea of creating wildlife corridors to connect these protected areas. The first such corridor was officially agreed with the Ministry of Forest and Water Affairs in December 2011 and publicly announced in June 2012. With a length of 82 kilometres, it will link the isolated Sarıkamış-Allahuekber National Park in the Kars region to the large Caucasus forests on the border with Georgia. With a surface area of 23,500 hectares and official status of 'Protected Forest', the corridor will be marginally larger than the national park itself.

"This corridor will provide additional habitat for large carnivores, will connect their isolated populations, and hopefully will also help reduce the local human–carnivore conflict," Şekercioğlu writes. "As Ardahan's Posof forests are connected to Georgia's Akhaltsikhe forests that border the 85,000 hectare Borjomi-Kharagauli National Park, Turkey's first wildlife corridor will also promote transboundary conservation in the region."

Two thirds of the area of the corridor is already covered by forests. The government agencies will carry out reforestation work to fill the gaps, which may take up to a decade, and hire park rangers for the protection of the area. Meanwhile, KuzeyDoğa will keep lobbying the politicians to ensure that the corridor is established as promised, and will also continue to study the ecology of the area, thus also providing a live coverage of the efficiency of the conservation measures, and to inform the public about the measures and the importance of the regional biodiversity.

Further wildlife corridors could drastically improve the value of the existing areas. "We are already talking with the ministry officials about an even bigger wildlife corridor connecting the forests on the Black Sea coast," Şekercioğlu says. "This region is mostly forested, so a thousand mile corridor crossing Turkey from Georgia to Bulgaria is not as difficult as it sounds. We also want the government to include all of Sarıkamış' remaining 400 km^2 of forest inside the boundaries of Sarıkamış National Park, not just a token 60 km^2." It looks like environmentalists in Turkey will have a lot of work to do for the coming years.

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Q & A

Mark H. Johnson

Mark Johnson is an MRC Programme Leader and Director of the Centre for Brain & Cognitive Development at Birkbeck, University of London. He obtained his first degree in Biology and Psychology from the University of Edinburgh, and his PhD in Behavioural Neuroscience from Cambridge University. In between two periods working as a Research Scientist at the MRC Cognitive Development Unit, London (1985–89 and 1994–98), he was a McDonnell Foundation and Human Frontiers Research Fellow at the University of Oregon, Eugene (1989–90), and Associate Professor of Cognitive Neuroscience at Carnegie Mellon University, Pittsburgh, USA (1991–95). He has published over 250 papers and 11 books on brain and cognitive development in human infants and other species, and has been Co-Editor of the leading journal Developmental Science *since 2001. His laboratory currently focuses on typical and atypical functional brain development in human infants and toddlers using several different brain imaging, behavioural and modelling techniques. He is a Fellow of the British Academy, and has received awards including the Queen's Anniversary Prize for Higher Education, the British Psychological Society President's Award, and the Experimental Psychology Society Mid-Career Award.*

What turned you on to biology in the first place? As a boy I considered several glamour professions — pilot, architect, sportsman, musician — but at the age of 13 or so I read some popular science books on the brain and mind, and was hooked. I decided from that point on to dedicate myself to the scientific investigation of how the physical jelly of the brain gives rise to the richness and complexity of the internal human mind, and the related 'big' question of how things got to be that way in the first place. Combining brain–mind questions with those of evolution and development seemed a good, and still relatively unexplored, place to go.

The next question was the more practical one of how to get the right education, as at the time most psychology degrees seemed very distant from basic biology. Fortunately, I discovered an unusual course at the University of Edinburgh that allowed me to do a degree in Biology with 'Honours' (final year specialization) in Psychology. My attempts to bridge between psychology and the rest of biology extended through to my PhD years. Under the wise mentorship of Gabriel Horn and Patrick Bateson at Cambridge I received what I now realise to have been an exceptionally broad research training in neuroscience, behavior and evolution. Even then, however, I managed furtive visits across campus to attend the Psychology department seminars. Perhaps it was only when I attended the very first McDonnell summer school in 'cognitive neuroscience' in 1988 that I felt I actually belonged to a recognisable field, albeit a very new and still emerging one. Since that time the cognitive neuroscience approach has thrived and expanded to dominate large swathes of psychology and neuroscience, and I have been particularly involved in promoting its development variant — now commonly called 'developmental cognitive neuroscience'.

Do you have a favourite paper? I will choose a book if I may, as I believe this form of publication still has an important role for the transmission of knowledge, even today, when the culture is dominated by peer-reviewed journal papers. As an undergraduate, I went to the University of Edinburgh book sale and came across the (cut price) works of C.H. Waddington. Waddington's books filled my evenings (at least when I was too broke to go to the bar). *The Evolution of an Evolutionist* (1975) was a good introduction, and I then moved on to the series *Towards a Theoretical Biology* (1968–72). While Waddington's well-known 'epigenetic landscape' metaphor still appears in many contemporary textbooks, some of his key ideas about the evolution and development of complex dynamic systems such as the brain have not yet had the influence I believe they merit. As noted in another influential book worth reading — Susan Oyama's *The Ontogeny of Information* (2nd edition, 2000) — most of us are still stuck in the vestiges of the traditional nature *versus* nurture debate.

What advice would you offer to someone starting a career in biology? First and foremost, identify a big question that motivates you and that can sustain and direct your research over the years. Remind yourself of your big question at regular intervals, as it is all too easy to get diverted into the back alleys of secondary issues. Next, don't be limited in your choice of research program by the hot topics of the day, as those topics will rarely still be hot a decade or two on (and following the crowd is not the wisest strategy when grant funding is tight). Finally, remember that science is a social activity more than an individual pursuit, and that most of biology these days necessarily involves interdisciplinary teams. So, treasure and nurture good collaborators, mentors, and team members.

What and who were your major influences? My primary PhD advisor, Sir Gabriel Horn, had an enormous influence on me and taught me how to be a good scientist, team leader, PhD mentor, professor, and all round academic. It is hard to think of any aspect of my research and academic life that has not been directly influenced by his example. Others have contributed in more specific but equally valuable ways: from John Morton and Jay McClelland I learned about the value and principles of rigorous theoretical modeling; and Mike Posner carefully nurtured and guided my attempts to establish developmental cognitive neuroscience as a new field.

What was your biggest mistake? Fortunately, I cannot remember a really significant one; however, there have been many occasions when I have sat around with collaborators in a deep gloom about a 'failed' experiment in which we obtained a quite different pattern of results from that predicted by our hypothesis. It is at this point that an ability to think creatively and 'out of the box' is most important. Hypotheses are important, but one needs to be ready to let them go when the data are telling you something different. Actually, some of my biggest discoveries have come from generating new hypotheses based on the unexpected patterns of data from such (apparently) failed experiments.

What is your favorite conference? When you are up and coming and want to get your work more widely known, the big international conferences are the places to go. As your career develops the allure of the crowds diminishes somewhat, and I now I prefer smaller conferences with more focused topics. Recently, I have enjoyed attending the "Wiring the Brain" conferences where biological scientists from a variety of backgrounds get together to shed light on questions of common interest about the mechanisms, phylogeny and ontogeny of brain wiring.

What are the big questions to be answered next in your field? I've had the privilege of being around for the birth of a new field, developmental cognitive neuroscience, and witnessed the dramatic increase in the number of people interested in the topic along with new conferences, journals and textbooks. Even though the field has grown from infant to toddler, many significant challenges remain. Perhaps the biggest of these is in integrating between levels of observation. We can observe events and changes in different aspects of brain structure and function, but how exactly do we relate these to changes in the overt behavior and cognitive ability of children during development? Just saying that the neural changes 'cause' the cognitive and behavioural ones is an unsatisfactory, and often misguided, type of explanation.

Bridging between levels of observation is becoming even more difficult now that we are devising better tools for analyzing genetics and epigenetics, as we now have a new level of data that needs to be brought into the picture. To my mind, part of the answer to this challenge lies in having better frameworks (general theories) to guide our thinking, and I have proposed one — Interactive Specialization. Another part of the answer to the challenge I suspect lies in formal computational models that incorporate and bridge how specific neural networks are

shaped by their activity — both intrinsic and environment induced — and how these networks support the brain computations that underlie externally observable behavior.

The second major challenge facing our young field will be applying the basic discoveries we are making to important real-world issues. It is a widely held view that understanding the brain bases of cognitive and behavioral development has potential for application to clinical issues, educational strategies, and societal policies. With a few notable exceptions, however, this still remains largely a promissory note.

What do you think is the future of scientific publication? As a long-standing journal editor, I get to see both sides of the publication process. The changes currently occurring in scientific publishing are probably the most rapid and dramatic since the original founding of the oldest scientific journals. Some of these changes are clearly positive, as web publication allows a move towards a more flexible and multi-dimensional version of the classic scientific paper: a new form of publication in which different levels of detail of information can be accessed and presented at the press of a key. Further, I suspect that web-publication will also lead to more creative ways to present complex data sets, as we move away from the limitations of the printed page. However, with rapid change there are also some potential negatives. Foremost among these concerns is the increasing difficulty in sorting out the wheat from chaff with the plethora of new web journals. While scientists can apply their critical faculties to papers post-publication, journalists often do not have the necessary background and assume that all journals have the same values and standards. Another concern is that a paradoxical side-effect of some search-engines is that only more recent literature gets cited. As a journal editor I am often reminding young authors about critical studies conducted before the advent of pdf files and doi numbers!

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Quick guide

Caulobacter crescentus

Velocity Hughes, Chao Jiang, and Yves Brun

What is* Caulobacter crescentus*? *Caulobacter crescentus* is an aquatic Gram-negative bacterium that thrives in nutrient-poor environments and exhibits an elaborate life cycle. It features regulated changes in cell shape and surface adhesion within the context of a dimorphic cell cycle that culminates in asymmetric cell division (Figure 1).

Why study* Caulobacter crescentus*? *Caulobacter*'s cell cycle allows easy synchronization of populations based on developmental stage, and cells display clear polarity that distinguishes their two ends. These properties facilitate spatiotemporal tracking of gene expression, protein subcellular localization, chromosome segregation, and growth over the course of *Caulobacter*'s life cycle. This has enabled detailed understanding not only of the mechanisms of bacterial differentiation and development, but also of widely conserved processes in chromosome replication and cell cycle regulation that were less tractable in symmetrically dividing model species such as *Escherichia coli.*

What happens during* Caulobacter*'s extensive metamorphosis? The cell cycle of *Caulobacter* is a visually striking display of bacterial development, with each life stage having a distinctive appearance (Figure 1). Major functional transitions accompany the morphological changes of the cell as it progresses through the cell cycle. The newborn swarmer cell is equipped with a flagellum and pili at a single pole. Incapable of DNA replication, the swarmer cell dedicates its energy towards motility and dispersal. With time, the flagellar pole of the swarmer cell undergoes differentiation. It secretes a polysaccharide adhesin known as the holdfast, which mediates permanent surface attachment of the cell. Then the flagellum and pili are lost from that pole and replaced by the growing stalk, which is a thin extension of the cell envelope. The stalked cell is reproductively mature and gives off daughter swarmer cells, marking the completion of the dimorphic life cycle.

How are the events of the* Caulobacter *life cycle coordinated so precisely? First of all, *Caulobacter* tightly regulates DNA replication initiation, allowing it to occur exactly once per cell cycle in the stalked stage. Overseeing this important routine is a protein called CtrA, which belongs to the response regulator family of transcription factors. CtrA not only prevents extraneous initiation of DNA replication, it also controls the expression and activity of a large number of important regulons involved in cell cycle progression. CtrA prevents the initiation of new rounds of DNA replication by binding to the chromosomal origin of replication; however, it undergoes timed degradation during the swarmer-to-stalked cell transition. This allows replication initiation and tightly coupled activation of various pathways involved in polar differentiation, growth and cell division, maintaining synchrony between the various events of the cell cycle. The activity of CtrA and its effectors marks the crucial transition that enables the emergence of complex development from the mechanistic foundations of functionally symmetric binary fission, in *Caulobacter* and other related organisms. The details of the functioning of this pathway therefore continue to be an extensive area of research in developmental microbiology.

Caulobacter*'s division gives rise to two cell types with distinct developmental fates — how does this occur?* Polarity in CtrA regulation between the two halves of the dividing cell drives developmental asymmetry between *Caulobacter*'s two daughter cell types. CtrA is synthesized and activated in the stalked cell shortly after DNA replication initiation. As the stalked cell progresses towards division, two important regulatory proteins,